Belief in pigs' capacity to suffer

Belief in Pigs' Capacity to Suffer: An Assessment of Pig Farmers, Veterinarians, Students, and Citizens

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Abstract

Intensive animal production practices lead to animal suffering worldwide. This study examined whether farmers cope with the negative impact of farming practices on their animals by ascribing them less capacity to suffer compared with other species. Most people like eating meat but find animal suffering emotionally disturbing. Human omnivores employ a variety of strategies to navigate this "meat paradox," and one of these is to reduce their perception of animals' capacity to suffer. Psychological defenses associated with meat-eating have been widely researched, but this study provides the first investigation into how these are employed amongst those involved in meat production and focusses on intensive pig producers as an example. Seventy-six pig farmers reported their belief in pigs' capacity to experience pain, hunger, fear, and boredom in a paper-based survey employing visual analogue scales. Their responses were compared with their perceptions of livestock that they did not farm (cows) and two companion animal species (dogs and cats). These results were compared with people who had similar experience of working with pigs (15 specialized pig veterinarians) and those who had had no experience of pigs (23 agricultural students, 22 animal science students, and 58 citizens unrelated to agriculture). The results of the 194 responses provide evidence to suggest that the pig farmers did not ascribe their animals a diminished capacity to suffer. Rather, pig farmers expressed an enhanced belief in pigs' capacity to experience hunger. All comparison groups expressed widespread belief in each species' capacity to suffer. Nevertheless, dogs were the species judged to be most capable of suffering, and animal science students gave the highest suffering scores overall. Farmers are directly responsible for the welfare of their animals, and further investigation into the

psychological and behavioral strategies of farmers may provide insight into non-financial reasons behind the generally slow progress in improving animal welfare.

Keywords: animal sentience, animal welfare, cognitive dissonance, farmers, human–animal interaction

Animal production is at an all-time high. World pork production doubled between 1985 and 2016 (Food and Agriculture Organization of the United Nations., 2018). Today over 1.3 billion pigs are slaughtered worldwide each year and production is expected to continue rising (OECD/FAO, 2018). Growing demand for animal products over recent decades has been driven by the growing human population (Gelbard, Haub, & Kent, 1999; Godfray et al., 2010) and by the growing consumption of meat as a result of increased incomes and urbanization (Delgado, 2003; Steinfeld, Wassenaar, & Jutzi, 2006). Demand for low-cost meat has driven intensification in some livestock sectors and low-input extensification in others (Steinfeld et al., 2006). Across the modern livestock sectors, economic market-driven constraints limit options for safeguarding animal welfare where this requires increases in fixed or variable costs. In the global commercial pig industry, the majority of animals are housed in indoor, intensive units with high stocking densities. These systems are sophisticated and highly engineered; designed for efficiency and maximum production at minimum cost. Nevertheless, such intensive systems are associated with numerous threats to animal welfare. This paper examines whether pig farmers cope with the impact of the farming system on their animals by ascribing them less capacity to suffer compared with other species.

Although intensive systems offer some welfare advantages (e.g., easy health inspection, controlled climate) pigs experience injuries, pain, and stress caused by aggression (Peden, Turner, Boyle, & Camerlink, 2018), tail biting (D'Eath et al., 2016), lameness (KilBride, Gillman, & Green, 2009), routine husbandry procedures such as tail docking (Wilson, Holyoake, Cronin, & Doyle, 2014), and lack of opportunity to display innate behaviors (Taylor, Main, Mendl, & Edwards, 2010). Breeding sow welfare is further challenged by the use of farrowing crates, the continued use of sow stalls in some countries (Baxter, Lawrence, & Edwards, 2012), and chronic hunger as a result of restricted diets (D'Eath, Jarvis, Baxter, & Houdijk, 2018; Meunier-Salaun, Edwards, & Robert, 2001). Therefore, adjustments to production practices to meet the growing consumer demand for low-cost meat is a leading cause of pig suffering worldwide.

Meanwhile, affectionate relationships between humans and companion animals are a fundamental part of contemporary life (Walsh, 2009). Pet ownership is increasing (European Pet Food Federation, 2016) and pet animals are commonly considered to be family members (Cohen, 2002). Most people find animal suffering emotionally disturbing and disapprove of harming animals (Braithwaite & Braithwaite, 1982; Schröder & McEachern, 2004). However, this disapproval rarely translates into ethical buying behavior (Carrington, Neville, & Whitwell, 2010; Schröder & McEachern, 2004; Te Velde, Aarts, & Van Woerkum, 2002). Therefore, many people hold inconsistent but simultaneous beliefs regarding animals: they have an aversion to harming animals but like animal products (Bastian & Loughnan, 2017; Loughnan, Haslam, & Bastian, 2010).

The psychological conflict between people's dietary preference for meat and their moral response to animal suffering is termed "the meat paradox" (Bastian & Loughnan, 2017; Loughnan et al., 2010). The inconsistencies between beliefs and behavior result in an unpleasant emotional state known as cognitive dissonance, whereby people become motivated to alter one of the inconsistent elements (Festinger, 1957). Some people alter their behavior by avoiding eating meat, and indeed most vegetarians in Western societies report moral concern for animals as a major factor in their dietary choice (Fox & Ward, 2008; Hussar & Harris, 2010). However, most people continue to eat meat. Whilst some make ethical buying decisions, many do not and employ a number of psychological defenses in order to reduce cognitive dissonance.

One of the main defenses employed by humans eating meat is the mental disengagement of *meat* from *animal*. Physical distance and lack of transparency in animal production allows consumers to avoid considering how animals are farmed (Hoogland, de Boer, & Boersema, 2005; Schröder & McEachern, 2004). Moreover, meat products are marketed, packaged, and sold in a way that does not remind the consumer of the animal from which it came (Hoogland et al., 2005); this reduces consumer empathy and disgust (Kunst & Hohle, 2016). In some countries the association is broken further through the use of language; for example, we eat "beef" and "pork" instead of cattle and pigs (Bastian & Loughnan, 2017). Therefore, disengagement from animal production allows consumers to buy and eat meat frequently with little or no discomfort (Bastian & Loughnan, 2017) or consideration of livestock suffering (Carrington et al., 2010). However, consumers are not always able to avoid the link between meat and animals, and when forced to consider the

animal-meat link one resolution is to alter beliefs about livestock. Several studies reveal that livestock are ascribed diminished mental states necessary to experience suffering (Bastian, Loughnan, Haslam, & Radke, 2012; Bilewicz, Imhoff, & Drogosz, 2011; Bratanova, Loughnan, & Bastian, 2011; Loughnan et al., 2010; Wilkins, McCrae, & McBride, 2015). The capacity to suffer has long been emphasized as the basis of moral concern for animals. This was famously articulated by philosopher Jeremy Bentham when he stated: *"*The question is not, Can they reason? nor, Can they talk? but, Can they suffer?" (1823). Therefore, by denying livestock the capacity to suffer, many omnivores restrict moral concern for animals which allows them to eat animals without experiencing discomfort.

Farmers are a fundamental component of livestock production systems: they are responsible for all aspects of animal husbandry, including the routine administration of painful procedures such as tail docking and teeth clipping. Therefore, farmers have heightened awareness of animal suffering and, unlike consumers, they are unable to rely on the mental disengagement of *meat* from *animal*. This regular, direct exposure and participation in animal production may leave farmers particularly susceptible to high levels of cognitive dissonance. Psychological defenses employed to resolve dissonance have been widely researched in consumers without a farming background. However, no research has investigated how these psychological defenses are employed by farmers in spite of the important implications for farm animal welfare. Specifically, farmers who ascribe their animals less capacity to suffer may be less inclined to make animal welfare improvements, and this may contribute to the generally slow progress in improving animal welfare (Millman, Duncan, Stauffacher, & Stookey, 2004; Peden et al., 2018). This study provides the first investigation into

dissonance-reducing strategies employed by farmers and focusses on intensive pig producers as an example. We hypothesized: 1) that pig farmers will ascribe pigs diminished mental states necessary to experience suffering compared with other species; and 2) that pig farmers will ascribe pigs with less capacity to suffer compared with citizens unrelated to pig husbandry.

Methods

Overview

The current study investigated pig farmers' perceptions of pigs' capacity to suffer through a paper-based questionnaire. This was compared with that of cows (a livestock species that they do not farm) and cats and dogs (companion animal species). Moreover, farmers' responses were compared with those of animal science students, agricultural students, specialized pig veterinarians, and citizens unrelated to agriculture.

Questionnaire

The questionnaire consisted of two parts. The first part collected information on age, gender, location (England, Scotland, Wales, Northern Ireland, Republic of Ireland), and experience of working with pigs. Farmers were also asked for their role on the farm, students were asked for their course title and year of study, and citizens were asked for their occupation. The second part was on animal suffering. The questions were designed and used in previous research with students (Paul & Podberscek, 2000) and measured participants' beliefs in the capacity of each of four species (dogs, cats, pigs, cows) to feel the sensations of hunger and pain and the emotions of fear and boredom. These sensations and emotions provide a brief but representative assessment

of participants' beliefs in animals' capacity to experience suffering and are relevant to the challenges imposed by commercial pig production. Participants indicated their responses by placing a vertical line at the point they felt most appropriate on a 100 mm visual analogue scale (VAS) that ranged from "no, not at all" to "yes, in a very similar way to people." Scores were obtained by measuring the distance from the left end of the response line to the center of the respondent's line. This process generated individual scores for hunger, pain, fear, and boredom for each of the four domestic species. The survey was piloted with three pig farmers and seven researchers and amended according to their feedback regarding the wording and appropriateness of questions. The final version of the questionnaire received internal ethical approval from the Human Ethical Review Committee at the University of Edinburgh. Informed consent was obtained from all participants.

Recruitment

Participants were recruited between January 2017 and June 2018. Seventy-seven pig farmers were recruited at farmer events held by Scotland's Rural College (n = 21), Teagasc (n = 27) and the Agricultural and Horticultural Development Board (AHDB) Pork (n = 29). Specialized pig veterinarians (n = 16) were recruited at the same farmer events (n = 11) and through snowball sampling (n = 5) whereby veterinarian participants recruited other veterinarians. Snowball sampling is an established technique for recruiting hard-to-reach or specialized demographics (Babbie, 2010). We recruited fully qualified specialized pig veterinarians rather than veterinary students as previous research employing the same questionnaire found that veterinary students change their perceptions over the course of their studies (Paul & Podberscek, 2000). Furthermore, veterinarians provide an interesting comparison group owing to

their comparable years' experience working in the pig industry as the farmers. Undergraduate students of animal science (n = 24) and agriculture (n = 32) courses were recruited following scheduled lectures and field trips held at Scotland's Rural College. The student populations provide interesting comparison groups because of their knowledge of farming and animals and lack of direct work experience with pigs. Moreover, the students' perceptions of animals' capacity to suffer are important as they are likely to work with animals in the future. As a control group, 66 citizens unrelated to agriculture were recruited through snowball sampling by one staff member and six PhD students. They recruited friends and relatives in their hometowns to fill out the questionnaire and these people in turn recruited further participants. It is possible that citizens shared some values with researchers which may have influenced their results. However, this method of recruitment was used in previous published research studying attitudes toward animal welfare (You, Li, Zhang, Yan, & Zhao, 2014) and allowed us to recruit people from across the UK and Ireland who did not know the purpose of the study. Furthermore, this method of recruitment avoided participant self-selection based on interest in the study content (e.g., it is likely that only participants interested in animals would respond to advertisements). Citizens unrelated to agriculture provided an important comparison group as they had no specialization or experience within the pig industry.

Demographics of the Final Sample

Two applied animal science students, nine agriculture students, and seven citizens were eliminated from the analysis due to reporting previous experience working with pigs. One farmer, one specialized pig veterinarian, and one citizen were also

eliminated due to missing answers. In total, 194 participants were included (see Table 1 for participants' age, gender, and experience working with pigs).

Insert Table 1

Pig farmers (n = 76) were located in England (n = 28), Scotland (n = 21), and the Republic of Ireland (n = 27). Farm size varied widely (Table 2) which is consistent with the structure of the industry (AHDB, 2014, 2015). Farmers were employed in a range of roles on the farm (Table 1) and were roughly representative of UK agricultural workers who are mainly male with a median age of 59 years (Defra, 2017). Applied animal science students (n = 22) were all based in Scotland and studying at Scotland's Rural College (SRUC) and were predominantly female (Table 1). This was observed previously in animal science student groups (Heleski & Zanella, 2006). Fourteen were in the third year and eight were in the fourth and final year of their course. Agriculture students (n = 23) were all based in Scotland and studying at SRUC. Twenty were in the third year and three were in the fourth year of their course. Specialized pig veterinarians (n = 15) were based in Scotland (n = 5), England (n = 9), and the Republic of Ireland (n = 1). Citizens unrelated to agriculture (n = 58) were based in Scotland (n = 12), England (n = 40), and the Republic of Ireland (n = 6). They were employed in a range of industries which roughly fell into a number of categories: education (n = 3), childcare (n = 3), administration (n = 7), management (n = 5), beauty therapy (n = 4), skilled trade/labor (n = 7), engineering (n = 2), marketing/design (n = 3), healthcare (n = 8), and being retired (n = 16). The sample is roughly representative of the UK population where 75.6% are employed across a range of industries (Office for National Statistics, 2018) and 18% exceed

traditional working age (Office for National Statistics, 2017); however, our sample was skewed towards females (Table 1).

Insert Table 2

Statistical Analysis

All statistical analyses were carried out using SPSS Version 25 (Armonk, NY, USA). Residual maximal likelihood (REML) analysis was used to analyze the data as it does not require a balanced design and is well-suited for studies with unequal group sizes, such as this one. Furthermore, REML allowed us to control for extraneous variables (gender, age, and location). Four REML models were run to investigate the factors that are associated with scores for species' ability to experience hunger, pain, fear, and boredom. These were treated as four separate response variables. Fixed effects in the models were gender (male, female), age, location (England, Scotland, Ireland), species (dog, cat, cow, pig), and occupation (farmer, specialized pig veterinarian, applied animal science student, agriculture student, citizen unrelated to agriculture). It was important to include gender, age, and location first in each model in order to control for the important demographic differences between our comparison groups. To test hypotheses 1 and 2, the interactions between occupation and species were investigated. If the hypotheses were met we would expect an interaction to occur and that the effect should reside with farmers devaluing pigs in comparison with other species (hypothesis 1) and citizens unrelated to agriculture (hypothesis 2). Non-significant interactions and fixed effects were removed and the model re-run in order to maximize our ability to robustly test the effect of the remaining terms in the model.

Inspection of the Akaike information criterion (AIC) values confirmed that the inclusion of non-significant terms did not improve model fit.

We detected a significant interaction between species and occupation for hunger score and investigated this further by running five one-way repeated measures ANOVAs to explore the effect of species (dog, cat, pig, cow) on hunger score for farmers, specialized pig veterinarians, agriculture students, applied animal science students, and citizens unrelated to agriculture (further investigating hypothesis 1). We also ran four one-way ANOVAs to explore the effect of occupation (farmers, specialized pig veterinarians, agriculture students, applied animal science students, citizens unrelated to agriculture) on hunger scores for dogs, cats, cows, and pigs (further investigating hypothesis 2). Although the main effects of occupation, species, gender, age, and location were not directly related to our hypotheses, significant main effects were followed up with post-hoc analyses; the results are reported in order to aid interpretation of the data and contribute to the literature regarding human perceptions of animals. All post-hoc analyses were conducted using least significant difference (LSD) tests, with Bonferroni adjustments made for multiple comparisons. Results were considered significant at $p < 0.05$.

Results

Mean judgements of animal capacity to experience hunger, pain, fear, and boredom for each occupation and species are in Table 3.

Insert Table 3

Test of Hypotheses

To test hypotheses 1 and 2, the interactions between occupation and species were investigated. There were no significant interactions between occupation and species on scores for pain, fear, and boredom, indicating that the effect of species on these scores did not depend on occupation. There was a significant interaction between occupation and species for hunger score (Table 4); ANOVA was employed to investigate if this interaction was determined by species (H_1) and occupation (H_2).

Insert Table 4

Test of Hypothesis 1: One-way repeated measures ANOVAs revealed a significant effect of species on hunger score for farmers ($F_{(3, 225)} = 5.626$, $p < 0.01$) and citizens unrelated to agriculture ($F_{(3, 171)} = 9.276$, $p < 0.0001$). Farmers assigned pigs a greater capacity to experience hunger than dogs (mean difference = 5.3; *SE* = 1.6; 95% CI = 0.9 to 9.8; $p < 0.05$), cats (mean difference = 6.4; *SE* = 1.7; 95% CI = 1.7 to 11.1; $p < 0.01$), and cows (mean difference = 4.0; *SE* = 1.5; 95% CI = 0.0 to 8.0; approaching significance at $p = 0.051$). Citizens unrelated to agriculture judged cows as less capable of experiencing hunger than dogs (mean difference = 11.1; *SE* = 2.6; 95% CI = 3.9 to 18.2; $p < 0.01$), cats (mean difference = 8.7; *SE* = 2.5; 95% CI = 1.9 to 15.4; $p < 0.01$), and pigs (mean difference = 6.0; *SE* = 2.1, 95% CI = 0.2 to 11.9; $p < 0.05$). All other occupations gave comparable hunger scores to each species ($p > 0.05$). Therefore, farmers did not diminish scores for pigs compared with other species; this does not support our first hypothesis (H_1: Pig farmers will ascribe pigs diminished mental states necessary to experience suffering as compared with other species*)*.

Test of Hypothesis 2: One-way ANOVAs revealed a significant effect of occupation on hunger scores for dogs ($F_{(4, 189)} = 2.832$, $p < 0.05$), cats ($F_{(4, 189)} = 3.076$, $p < 0.05$), cows ($F_{(4, 189)} = 4.739$, $p < 0.01$), and pigs ($F_{(4, 189)} = 3.185$, $p < 0.05$). Post-hoc analysis revealed that these significant effects were determined by applied animal science students judging dog capacity for hunger to be greater than that scored by farmers (mean difference = 11.5, *SE* = 3.6, 95% CI = 1.2 to 21.7, $p < 0.05$); cat capacity for hunger to be greater than that scored by farmers (mean difference = 12.2, *SE* = 3.8, 95% CI = 1.3 to 27.8, $p < 0.05$) and agriculture students (mean difference = 14.3, *SE* = 4.7, 95% CI = 0.9 to 27.8, $p < 0.05$); and cow (mean difference = 17.6, *SE* = 4.4, 95% CI = 5.2 to 30.1, $p < 0.01$) and pig (mean difference = 11.3, *SE* = 3.4, 95% CI = 1.6 to 21.0, $p < 0.05$) capacity for hunger to be greater than that ascribed by citizens unrelated to agriculture. Therefore, farmers did not diminish scores for pigs when compared with citizens unrelated to agriculture; this does not support our second hypothesis (H_2: Pig farmers will ascribe pigs with less capacity to suffer compared with citizens unrelated to pig husbandry).

Tests of Main Effects

The results of main effects in each REML model are reported here.

Main Effects of Occupation: There were significant main effects of occupation on scores for hunger, pain, fear, and boredom across all species (Tables 3 and 4). Applied animal science students scored the capacity for hunger higher than farmers (mean difference = 6.9, *SE* = 2.0, 95% CI = 1.2 to 12.7, $p < 0.01$), agriculture students (mean difference = 9.2, *SE* = 2.3, 95% CI = 2.7 to 15.6, $p < 0.01$), and citizens unrelated to agriculture (mean difference = 7.2, *SE* = 2.3, 95% CI = 0.7 to 13.6, $p < 0.05$); pain to

be higher than was scored by farmers (mean difference = 8.5; *SE* = 2.2, 95% CI = 2.2 to 14.7, $p < 0.01$) and citizens unrelated to agriculture (mean difference = 8.8, *SE* = 2.1; 95% CI = 2.8 to 14.8, $p < 0.001$); and fear to be higher than was scored by farmers (mean difference = 10.5, *SE* = 2.2; 95% CI = 4.3 to 16.6, $p < 0.001$), specialized pig veterinarians (mean difference = 8.5, *SE* = 3.0, 95% CI = 0.0 to 17.0, $p < 0.05$), agriculture students (mean difference = 8.2, *SE* = 2.7, 95% CI = 0.7 to 15.8, $p < 0.05$), and citizens unrelated to agriculture (mean difference = 13.3, *SE* = 2.3, 95% CI = 7.0 to 19.7, $p < 0.001$). Applied animal science students also scored the capacity for boredom higher than any other group (Table 3,), but once differences in age, gender, and location were accounted for in the statistical model their responses were comparable to all other groups ($p > 0.05$). Farmers gave higher boredom scores than citizens unrelated to agriculture (mean difference = 10.5, *SE* = 2.8, 95% CI = 2.7 to 18.3, $p < 0.01$).

Main Effects of Species: There were significant main effects of species on scores for pain, fear, and boredom, but not hunger, across all occupations (Tables 3 and 4). Dogs received higher pain scores than cows (mean difference = 6.5, *SE* = 1.5, 95% CI = 2.6 to 10.4, $p < 0.001$) and pigs (mean difference = 4.2, *SE* = 1.5, 95% CI = 0.3 to 8.1, $p < 0.05$); higher fear scores than cats (mean difference = 5.1, *SE* = 1.8, 95% CI = 0.2 to 9.9, $p < 0.05$) and cows (mean difference = 7.1, *SE* = 1.8, 95% CI = 2.2 to 11.9, $p < 0.01$); and higher boredom scores than cats (mean difference = 10.3, *SE* = 2.6, 95% CI = 3.4 to 17.2, $p < 0.01$), cows (mean difference = 16.8, *SE* = 2.6, 95% CI = 9.9 to 23.7, $p < 0.001$), and pigs (mean difference = 7.0, *SE* = 2.6, 95% CI = 0.1 to 13.9, $p < 0.05$). Pigs received higher boredom scores than cows (mean difference = 9.9, *SE* =

2.6, 95% CI = 3.0 to 16.8, $p < 0.01$). Cats' boredom scores were comparable to those of both pigs and cows ($p > 0.05$).

Main Effects of Age, Gender, and Location: Females gave higher scores than males for pain (mean difference = 3.0, *SE* = 1.3, 95% CI = 0.4 to 5.6, $p < 0.05$) and boredom (mean difference = 5.5; *SE* = 2.4, 95% CI = 0.9 to 10.1, $p < 0.05$), but gender did not affect hunger or fear scores (Table 4). There were significant main effects of age on scores for hunger and boredom but not pain or fear (Table 4). These were determined by significant but weak negative correlations between age and hunger score ($r = –0.187$, $p < 0.001$) and age and boredom score ($r = –0.202$, $p < 0.001$): older respondents regarded all species as less capable of experiencing hunger and boredom. Participants from Ireland scored the capacity for pain to be higher than those located in England (mean difference = 4.4, *SE* = 1.6, 95% CI = 0.6 to 8.3, $p < 0.05$) and Scotland (mean difference = 5.0, *SE* = 1.7, 95% CI = 0.8 to 9.2, $p < 0.05$), but location did not affect hunger, fear, or boredom scores (Table 4).

Discussion

In order to minimize psychological discomfort, some people who eat meat make ethical buying decisions whilst many mentally disengage *animals* from *meat* (Bastian & Loughnan, 2017; Hoogland et al., 2005; Schröder & McEachern, 2004). When forced to face this link, one resolution is for people to reduce their perception of animals' capacity to suffer (Bastian et al., 2012; Bilewicz et al., 2011; Bratanova et al., 2011; Loughnan et al., 2010; Wilkins et al., 2015) and hence their moral concern for animals. Farmers are unable to avoid the link between animals and meat, and this study provided the first investigation into whether they cope with the adverse effect of

the farming system on their animals by ascribing them diminished capacity to suffer. The results do not support our hypothesis that pig farmers ascribe the species diminished mental states necessary to experience suffering.

Test of Hypotheses

There were no significant interactions between species and occupations for pain, fear, and boredom, indicating that the effect of species on these scores did not depend on occupation. Where a significant interaction did occur (hunger) it did not reside with farmers devaluing pigs in comparison with other species (hypothesis 1) and citizens unrelated to agriculture (hypothesis 2). In fact, farmers judged pigs as more capable of experiencing hunger than each of the other species. Sows are feed-restricted for management purposes and express their hunger through vocalizations and (redirected) feeding behavior (D'Eath et al., 2018). Farmers are therefore exposed daily to sows' chronic hunger (Tolkamp & D'Eath, 2016) and their responses may thus be influenced by knowledge about the animals' capacity to experience that sensation. Moreover, their response could be linked to greater empathy because of experience. Exposure and contact are known to enhance empathy between humans (Dovidio, Gaertner, & Kawakami, 2003; Pettigrew & Tropp, 2008); this has more recently been demonstrated in human–animal relationships (Morris, Knight, & Lesley, 2012). However, it is important to note that the specialized pig veterinarians had comparable years' experience working with pigs but no significant effects were detected for this group. Nevertheless, veterinarians are not responsible for animal husbandry and their exposure to sow hunger will therefore differ from farmers'. Scientists express widespread belief in the emotional lives of animals, including those that they use in their research (Knight, Vrij, Bard, & Brandon, 2009). Along with the results of the

current study, this demonstrates that animal husbandry and the experimental use of animals can still be supported even when animals are perceived to be capable of suffering. Moreover, it fails to support an important prediction from current psychological theory: farmers will deny their animals more mind.

Effects of Occupation on Perceptions of Animals' Capacity to Suffer

Although respondents from all occupations expressed belief in animals' capacity to suffer, there were differences between groups in their attribution of each sensation/emotion. Even after controlling for demographic differences, applied animal science students gave higher scores than farmers, veterinarians, agriculture students, and citizens for fear; higher scores than farmers and citizens for pain, and; higher scores than farmers, agriculture students, and citizens for hunger. Furthermore, animal science students judged dog capacity for hunger as greater than did farmers, cat capacity for hunger greater than did farmers and agriculture students, and cow and pig capacity for hunger greater than did citizens unrelated to agriculture. Farmers were comparable to specialized pig veterinarians, agriculture students, and citizens in their scores for hunger, pain, and fear, but gave higher boredom scores than citizens unrelated to agriculture. These results are consistent with evidence that stakeholders view animals differently based on their different values, norms, convictions, interests, and knowledge (Te Velde et al., 2002). For example, animal science students are known to hold strong values and interests regarding animal welfare (Heleski & Zanella, 2006) and learn about animal suffering during their course. Capacity to suffer is emphasized as the basis of moral concern for animals and belief in animal sentience is a strong predictor of attitudes towards animals and their use (Knight et al., 2009; Knight, Vrij, Cherryman, & Nunkoosing, 2004). Therefore, the widespread belief in

animals' capacity to suffer expressed by our comparison groups is positive, particularly as the student populations are likely to work with animals in either agricultural or scientific contexts in the future, whilst farmers and veterinarians are currently responsible for the welfare of animals under their care.

Effects of Species on Perceptions of Animals' Capacity to Suffer

All species (dogs, cats, cows, and pigs) were judged to have the capacity to experience a range of negative sensations and emotions (hunger, pain, fear, and boredom). This is consistent with a survey of 200 members of the public which revealed widespread belief in animal sentience across a variety of species (Morris et al., 2012). Nevertheless, our study detected some important differences in the attribution of pain, fear, and boredom between species, with dogs receiving the highest scores. There were no differences between species in the attribution of hunger (unless controlling for the effect of occupation, see section above titled "Test of hypotheses"). Specifically, dogs were believed to be able to experience pain more than cows and pigs; fear more than cats and cows; and boredom more than cats, cows, and pigs. This is consistent with a survey of 425 students which found that dogs are perceived as highly sentient, exceeding new born babies, followed by foxes, pigs, chickens, rats, and fish (Phillips & McCulloch, 2005). In the current study, pigs were judged as comparable to dogs, cats, and cows in their capacity to feel fear. They were comparable to cats and cows in their capacity to feel pain, and comparable to cats, but more capable than cows, of feeling boredom. The attribution of human-like experiences and cognitive abilities to animals is known to be influenced by the degree of attachment to that species, with food animals attributed diminished capacity to suffer (Bastian et al., 2012; Bratanova et al., 2011; Eddy, Gallup, & Povinelli, 1993;

Loughnan et al., 2010; Wilkins et al., 2015). It is therefore somewhat surprising that pigs were consistently judged to have similar emotional capabilities to cats, and they were judged more capable of feeling boredom than cows. Furthermore, citizens unrelated to agriculture judged pigs as comparable to cats and dogs, and more capable than cows, of experiencing hunger.

Davis and Cheeke (1998) carried out a survey of university staff and students in the US and found that non-food animals were judged to be more intelligent than livestock species, with the interesting exception of pigs who were judged to be comparable in intelligence to cats and dogs. The authors suggest that this could be due to the depiction of pigs in popular books and television programs as highly intelligent in comparison with other species produced for food (this has also been noted elsewhere: Arnold, 1988). Furthermore, a survey of animal science students found that pigs were judged as more capable of experiencing pain and boredom than cows (Heleski & Zanella, 2006). Therefore, the current study contributes to the evidence that pigs are a livestock species perceived to hold strong mental capacities, and indeed this is supported by studies of pig cognition (Mendl, Held, & Byrne, 2010).

Effects of Age, Gender, and Location on Perceptions of Animals' Capacity to Suffer

There were some important demographic differences between our comparison groups. For example, pig farmers were predominantly male and on average exceeded 40 years of age, whilst animal science students were predominantly female and on average younger than 25 years old. These demographic differences were unavoidable in order to maintain the representativeness of each population. We controlled for demographic factors in our statistical models and the results confirmed that it was crucial to do so.

Female participants judged animal capacity to experience pain and boredom to be greater than did males. This is consistent with previous research employing the same questionnaire which found that female veterinary students regarded cats and cows as more likely to feel pain than did male students (Paul & Podberscek, 2000). Furthermore, there is consistent evidence that, on average, females show higher levels of positive behaviors and attitudes toward animals; for example, by expressing greater empathy for animals (Colombo, Crippa, Calderari, & Prato-Previde, 2017; Hills, 1993), showing more opposition to animal use, and having greater involvement in animal protection activities (Heleski, Mertig, & Zanella, 2006; Herzog, 2007). Furthermore, we found weak negative correlations which revealed that older participants expressed less belief in animals' capacity to experience hunger and boredom than did younger participants. This is inconsistent with a survey of 96 members of the UK public which found that older participants had greater belief in the mental capacities of animals (Knight et al., 2004). The study, though, used different terms, and subsequent research indicates that younger people are most concerned about animal welfare (Vanhonacker, Verbeke, Van Poucke, & Tuyttens, 2007). Participants in Ireland reported higher pain scores than did those in England and Scotland, although our sample size from the Republic of Ireland was smaller than that from Scotland and England. This implies that there may be cultural differences in perceptions of animal pain. This warrants further investigation.

Study Limitations and Directions for Future Research

There are several limitations to the current study which are important to highlight. Regarding the participants sampled, the student populations were limited to one institution and therefore the results cannot be generalized to student populations

elsewhere. None of our respondents were based in Northern Ireland or Wales; therefore, our sample cannot be considered fully representative of the UK population. Furthermore, the sample of specialized pig veterinarians was small owing to difficulties in reaching this specialized demographic; this could have increased the risk of Type II errors, owing to a lack of statistical power. It is also possible that participants were influenced by experimenter effects whereby they responded in a way that they thought was desired rather than how they actually felt. Nevertheless, we did attempt to control for this bias by ensuring that all participants knew that their responses were confidential and could not be tied to any individual. Finally, a primary limitation of the current study was the restricted range of species, sensations, and emotions surveyed. A focus on a small number of species, and the emotions and sensations most likely to be directly elicited by common pig husbandry practices, was necessary to achieve a robust sample size.

The limited survey and study design employed here therefore provides only an initial exploration into this subject area. The extensive research into strategies employed by human omnivores to reduce cognitive dissonance provides several directions for future research. First, future research should build upon these findings by including a greater range of species and capacities, including higher-order traits, such as intelligence and secondary emotions, as employed in prior research into omnivores (Bastian et al., 2012; Bilewicz et al., 2011; Morris et al., 2012). Second, human omnivores display flexibility in their perceptions of animal sentience depending on recent behavior (Loughnan et al., 2010); this suggests that farmers' responses to the current survey may have been influenced by recent behavior. All farmers participated at farmer discussion groups rather than on the farm or whilst working with pigs.

Repeating the current study whilst experimentally manipulating the timing of farmer participation (e.g., during painful husbandry tasks such as tail docking and tagging, at weaning, or at slaughter) may reveal that their perceptions of pig capacity to suffer change when being directly confronted with animal suffering. This could be developed further by including measures of farmer discomfort with such procedures as a potential mediator of any reductions in mind attribution. Third, human omnivores rationalize meat-eating by endorsing positive beliefs about meat that fit with their dietary practices. They defend eating meat as necessary (for health), natural, normal, and nice (the 4Ns: Piazza et al., 2015). People who endorse the 4Ns tend to attribute fewer mental capacities to cows, include fewer animals in their circle of moral concern, consumed more animal products, are not motivated by ethical concerns in their buying decisions, and experience less guilt about their animal-product decisions (Piazza et al., 2015). Piazza et al. (2015) concluded that the 4Ns are a powerful, pervasive tool employed by individuals to reduce cognitive dissonance, but to date the use of the 4Ns has never been investigated in farmers. Fourth, human omnivores adjust perceptions of personal responsibility by placing the blame with other stakeholders, such as retailers and the government (Bastian & Loughnan, 2017; Schröder & McEachern, 2004); some evidence suggests that farmers employ this strategy (Te Velde et al., 2002). This may be particularly relevant if farmers feel constrained in their ability to improve welfare owing to small profit margins. Finally, human omnivores emphasize "responsible" behavior; for example, by under-reporting how frequently they eat meat, limiting their meat intake, or only eating certain types of meat (Bastian & Loughnan, 2017; Rothgerber, 2014, 2015a, 2015b). It is possible that farmers employ an equivalent strategy by emphasizing responsible behavior on their farm. The strategy employed to reduce dissonance is likely to depend on a range

of contextual factors, and when one fails another will take hold (Bastian & Loughnan, 2017).

Therefore, psychological defenses employed by omnivores to resolve dissonance have been widely researched and have important implications for animal consumption. However, no research has investigated how these additional psychological defenses are employed during the meat production process itself. Farmers are directly responsible for the welfare of their animals, and the psychological and behavioral strategies that they employ may have important implications for their motivation to improve animal welfare. This is therefore an important area of future research.

Conclusions

We found that pig farmers ascribed pigs with similar capacities to suffer as cows, dogs, and cats and showed similar outcomes to agriculture students, animal science students, pig veterinarians, and citizens unrelated to agriculture. This study provides the first investigation into cognitive dissonance related to the "meat paradox" in farmers. Cognitive dissonance mechanisms might be at play in farmers and this might affect their incentives to improve farm animal welfare. This deserves further investigation.

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Conflicts of Interest

The authors declare no conflict of interest.

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